2021 REPORT ON THE SMALL FISH PROJECT

SUBMITTED BY THE

CSIR-FOOD RESEARCH INSTITUTE TEAM

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Small Fish and Food Security: Towards innovative integration of fish in African food systems to improve nutrition.

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Executive Summary

This report presents a summary of activities undertaken by the CSIR-Food Research Institute team of the SmallFishFood Project. The contents of this document are captured as activities conducted in the four quarters of the year under review.

In the first quarter of 2021, the project team embarked on a field trip to evaluate the extent of uptake of the technologies. It came to light that, the fish processors who were predominantly women, were satisfied with the dried fish output from the racks and would have wished that the racks were fairly distributed among them. Also, samples of small fish were shipped to Norway for evaluation of its nutritional content under a PhD research study.

The second quarter activities entailed field trips to Ningo-Ahwiam, one of the fishing communities along the western coast of the Greater Accra Region. The Ningo-Ahwiam community whose inhabitants are largely involved in sun drying was selected as a beneficiary community to benefit from the Project interventions. Again, more samples of small fish were shipped to Germany and Norway for analysis in line with a student PhD research. As part of efforts to document research output from the Project, the FRI Team drafted scientific manuscripts for publication in high impact journals.

In the third quarter, wooden raised platforms, 40 drying racks and a hammer mill were constructed/fabricated and installed for the Ningo-Ahwiam Community.

During the last quarter of 2021, a simple shed was constructed for the Ningo-Ahwiam Community to house the hammer mill. The raised platform and drying racks were presented to the women fish processors in the Community to enable them dry fish hygienically. A training and technology transfer workshop was also organized for the fish processors at the Ningo-Ahwiam Community center.

1.0 Introduction

Mindful that the small fish industry in Ghana serves as a source of food security, nutrition and employment for fishermen and fish processors, the SmallFishFod project, an interdisciplinary project, sought to improve production processes to achieve better quality fish with longer shelf life.

The CSIR-Food Research Institute team of the project transferred technology on various value added products to empower women fish processors to see the endless possibilities of utilizing their 'raw materials', the alternative processing value chains and income earning channels that are available to improve their livelihood and improve nutrition.

Small sun-dried fish is a popular fish consumed in Ghana. This fish is usually dried on the bare ground at the mercy of dirt, dust and other contaminants. This practice could cause significant risks to its safety. Concerned about the possible effects and implications of such practice, the CSIR-Food Research Institute team delivered some interventions that improve fish quality and safety, as well as presented the opportunity for diversification in fish products, having empowered women in Tema New Town, Moree and Adina in the previous years.

In 2021, the year under review, the project also empowered women in Ningo-Ahwiam, Dangbe West in the Greater Accra Region to produce safe, cleaner, fish thereby improving the quality of their sun dried fish. This made it more marketable in a bid to raise their income and reduced spoilage/waste especially in the rainy season when their dried fish are washed away by the rain. Details of these Project activities have been captured on a quarterly basis in this report.

1.1 First quarter 2021

In the first quarter, the CSIR-FRI team visited Moree, Adina and Tema New Town communities to evaluate the uptake of training and technologies transferred. Still in the first quarter, processing (smoking and drying) of small fish and storage experiments were conducted in three regions of Ghana, namely the Greater Accra, Central and Volta regions. Data was also collected on fish consumption in four regions of Ghana as part of PhD research of a student and samples of developed small fish based food products were shipped to Norway for nutritional analysis. Details of the study are summarized below.

Summary of Student Work's

In one of the students' works, the objective was to use improved sun-drying and solar drying methods in the production of dried anchovies (*Engraulis Encrasicolus*) and Atlantic bumper fish (*Chrysurus*) powder and incorporate them into new food formulations. The results indicated that the solar dryer had a significantly faster drying rate than the sun drying methods. However, because the temperature within the solar dryer was higher, the dried fish were brittle in texture and less whitish in colour compared to the sun dried fish which were springier with a brighter white colour.

From the results obtained, moisture content (MC) of the fish was directly proportional to crude fat content; crude fat decreased with decreasing MC. On the contrary, nutrient content increased with decreasing MC in the solar dried fish. Histamine and heavy metal concentrations were within acceptable limits. Also, the solar-dried samples had the least microbial load compared to the fresh and other dried samples. Drying on the raised concrete platform with netted drying racks offered some form of protection from contamination by the environment due to the elevation of the drying surface from the ground. These, also had minimal microbial load and were within acceptable limits compared to samples dried on the bare ground and raised concrete platform without any form of covering. In comparison with artisanal fish samples from processing sites, it was observed that seasonal changes and mode of processing had a significant effect on the nutritional and microbial quality of dried fish.

With regards to consumer acceptability studies conducted on the developed products, i.e. biscuit and instant cereal mix prepared from fish powder, consumers referred products with a low fish concentration because in higher quamtities, a fishy smell or aroma was preceived in the products.

		
Drying on raised concrete platform	Drying on racks on raised concrete platform	Drying in solar tunnel dryer

Processing (smoking and drying) and storage experiments

Study Area

In another student work, studies were conducted in three regions of Ghana, namely Greater Accra, Central and Volta regions. Two fishing communities were selected from each region. These communities are widely known for processing and storage of fish namely Tema Newtown and Nungua in the Greater Accra region; Moree and Ekon in the Central region and Keta and Adina in Volta region.

Sample Collection

Fresh anchovies were bought by the fish processors from the landing beaches. The fishes were packed into crates, baskets or plastic containers. Prior to processing of the fish, samples were aseptically collected for microbial analysis. Samples collected in Accra were placed in an ice chest containing ice packs and immediately transported to CSIR-FRI institute for analysis. Samples taken outside Accra were collected aseptically into an ice chest containing ice packs and kept in a deep freezer (-14^{0}C to -18^{0}C) until brought to CSIR-FRI for analyses. About 1.2kg (triplicate of 400g) of the fish samples were collected from each processor.

Processing of Anchovies

Anchovies were processed for further study using smoking and drying techniques. The ovens used for smoking were the “Chorkor” and “Ahortor” ovens. Sun drying was carried out on wooden racks placed on raised platforms and on the bare floor. The smoking process lasted between 30 - 40 hours depending on the type of oven used, whereas the sun drying process spanned between 72

– 96 hours based on whether it was dried on the floor or the racks. During processing, about 40 individual fishes were randomly selected and the total length, fork length and weight were measured.

Storage of anchovies

After processing, the fishes were packed into separate baskets lined with water proof paper and covered with polythene. The technique used in the packaging is the same as practiced by the processors. The baskets were labelled and kept at locations where other processed fishes are kept by the processors. Samples were taken and shipped to Germany and Norway after 3, 6 and 9 months for further analysis.

Nutrient Profile and Shelf Life Study

The products developed under the project were evaluated for their consumer acceptability, nutrient profile and studied over a six-month period to ascertain their quality during storage. Important parameters that would determine the product quality and consumer acceptability studied within the period were moisture, pH, free fatty acid (FFA) content, peroxide value (PV), aerobic mesophiles, yeast and moulds, Enterobacteriaceae, *E. coli*, *Staphylococcus aureus,* and *Salmonella spp.* These were assessed at designated intervals of 0, 1, 3 and 6 months. Another batch of food products developed were sent to Norway for nutrient profile analyses including protein, vitamins, fat, energy, calcium, zinc, sodium, iron, iodine and others are also ready. Results of these analyses would be presented in a manuscript under preparation.

1.2 Second quarter 2021

Site Identification

In the second quarter of 2021, trips were made to the Ningo area, following the leads given by the President of National Association of Fish Processors and Traders (NAFPTA) to identify sites that were into significant processing of fish using the sun-dried method. Based on interactions with the women and by observation of activities, the Ahwiam Community in Ningo was selected as a beneficiary community. The team had engagements with the key stakeholders such as opinion leaders, chief fisherman and leadership of the women processors. The community after

deliberations allocated a piece of land close to their existing fish drying ground for the platform erection and a nearby house for the hammer mill.


Engagement with stakeholders and women leadership


Land allocation

A second batch of samples of processed (smoked and dried) small fish for storage experiments were also shipped to Germany and Norway. The team also continued with Data analysis and write ups on other manuscripts this quarter.

1.3 Third quarter 2021

Construction of wooden raised platforms and 40 drying racks

The construction of wooden raised platforms and 40 drying racks was undertaken on land allocated by the Ningo-Ahwiam community in the 3rd quarter and the hammer mill was also fabricated and erected. Off-the-ground drying platforms and drying racks were constructed for the women fish processors at Ningo-Ahwiam as had been done at the other fish landing sites. The platforms and racks provided an alternative means of processing fish by sun drying with improved, cost-effective, user-friendly technologies. The design of the racks even though one-sided netting and wire mesh, allowed for easy flip-over to dry the bottom side of dried products when another racks is placed over it. This design was based on feedback given by the women processors and this was incorporated to encourage them to make full use of the racks. The affordable alternative drying platform has a wooden drying frame on which the racks are placed, and supported on concrete stands to ensure stability and durability of the platforms.

Construction phase of raised platforms

Constructed racks and shed for hammer mill

Fourth quarter 2021

Following the successful fabrication and completion of the racks, platforms and hammer mill, a training and technology transfer workshop was held on the 12th of October, 2021 for the Women processors of the Ningo-Ahwiam community.

Opening Addresses - Training and technology transfer workshop

The program was attended by Professor Wisdom Amoa Awua, a Chief Research Scientist of the CSIR Food Research Institute who is also a supervisor to the MPhil student on the project. The president of the National Fish Processors and Traders Association (NAFPTA) - Madam Regina Solomon, representatives of the Fisheries Commission (Post Harvest Directorate) led by Mr. Salahudeen A. Mustapha and the Ghana New Agency were also present.

After the opening and introduction of dignitaries, the Principal Investigator of the project (Mrs Amy Atter) gave a brief overview of the project and its objectives, and mission for the Ningo-Ahwiam Community. Madam Regina Solomon and Mr. Dean, also urged the women to participate fully in the workshop, to acquire new skills that can earn them additional income to support and take care of their children. A minute of silence was observed for the repose of the soul of Mr.

Manu formerly of the Fisheries Commission who in his life time was passionate about post-harvest fisheries activities in Ghana.

Training of women fish processors on hygienic fish handling

A few of the women were asked to explain how they handled their small fish prior to drying. From the responses, there was no standardized way of handing fish. They usually washed their fish once with the sea water, while others washed it twice in the sea water.

However, during the training, they were advised to wash their fish twice in pipe borne water because of contamination in the sea water as a result of bathing, defecation and other unhygienic practices. They were also trained to salt the water prior to washing of fish and rather than dry on the ground, dry on the racks and raised platforms provided to improve the hygienic quality of the fish and prevent their fish from being washed away by rain.

Women with basins of water to wash fish hygienically

Salting of water prior to fish washing

Rinsing of fish

Rinsing of fish

Rinsing of fish

Drying of fish on racks

Using the developed training manual, the women had a hands-on trial drying their fish on racks mounted on wooden platform. This practice would lead to better quality dried fish and prevent fish loss as a result of rains. As shown below, the pools of water created by rains would have washed their dried fish away.

Women drying fish on racks provided

Pool of water that would have washed fish away if not for the racks and platform provided

Deheading and degutting of fish

The women had a session of deheading and degutting of anchovies. This process removes the bitterness of dried anchovies, thereby preventing foods cooked with it from having a bitter after-taste. They were advised to mill whole all other small fish species that does not produce bitter after-taste as they are very nutritious. A young man proposed by women was also trained to operate the mill for them.

Demonstrating the use of the hammer mill and sealer

Explaining the use of the equipment

Stages of milling fish with the hammer mill

Bagging of milled fish

Demonstrating use of sealer

Woman using the sealer

Trial demonstrations were done by the Engineer on the team for the women to observe how the milling and sealing (packaging) is done. A young man within the community was also trained on operating the hammer mill and sealer so that he can assist with milling always.

Training and Technology transfer and food product development

The women were trained on making products such as biscuits, doughnuts and *shitor* (a pepper sauce), fortified with sun-dried fish flour. They also had the opportunity of not just watching the process, but also having hands on experience of making biscuits, doughnuts and *shitor*.

Training on developing products

Women making products (Biscuits)

Women making *shitor*

Women making doughnuts

Handing over

At a simple handling over ceremony, the project team lead by the PI handed over the drying platform, 40 drying racks, hammer mill and sealer to the leadership of the fish processors and traders of Ningo-Ahwiam. She encouraged them to make good use of these racks to enhance the quality of their dried fish, prevent loss and add value to the fish to generate more income.

Handing over of racks

Handing over of sealer and hammer mill

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At the end of the training, the women were very happy with the knowledge acquired on the alternative uses of sun-dried fish for making products such as biscuits, doughnuts and *shitor*. The training session was very interactive, enabling then to have hands-on practical training on the products developed. The training was also interspersed with short quizzes geared at helping them to remember the recipes. They were also handed booklets and leaflets on hygienic handling of fish. The women pledged to put the equipment provided and the training received to good use to improve their lives. The Project also provided portable sealing machines for packaging of sun-dried fish products and hammer mills to mill (grind) the dried de-headed and de-gutted fish into powder. The women were trained in the operation of the hammer mill, correct use of the drying racks and practically trained in the utilization of fish powder for various food preparations such as shitor, fish doughnuts and fish biscuits.

Women with a display of products they had made

First Evaluation

The extent of uptake, challenges, suggestions and observations on the technologies transferred by the CSIR-Food Research Institute team to the communities in the Greater Accra Region, Central Region and Volta Region namely Tema New-Town, Moree and Adina were evaluated. The evaluation was embarked upon in March, 2021. The afore-listed communities had been presented with drying platforms, drying racks, a hammer mill and a sealer. The women fish processors had also been trained on hygienic handling and processing of small fish as well as development of the value added products as alternative livelihoods. Based on this, it was expected that these raised drying racks and platforms would have been used to their benefit. It was also hoped that they (women processors) had started their own small scale production activities and developing some of the products they had been trained on.

The evaluation was conducted over one year from that date of handover of technologies to the Moree Community. However, during the time of evaluation visit, it was found that the construction of the landing beach at Moree had stalled fish processing to a large extent. Interaction with the Chief Fisherman indicated that the women had challenges with the siting of the platform. They were not enthused about the distance they had to walk to dry their fish. Also importantly, because of the distance they could not guarantee the safety of their fish if it was left to dry at a location far from their home. They would therefore have preferred to own the racks.

The good thing however was that, they had understood the concept of hygienic processing and from time to time borrowed the drying racks for use in their homes, and returned them when the fish was dry. The chief fisherman promised that when the development at the landing beach is completed, he will move the platform and racks to the landing beach, closer to the women to enable them monitor their fish during drying at his own cost.

The situation at Adina however was different, the women processors interviewed contributed immensely by way of observations they had made using the drying racks and suggestions for improvement. These are as follows:-

Observations:

1. They indicated that, small fish generally caught in the Adina area were smaller in size. As a result, these fish fall through the wire mesh on the drying racks during drying. This made it difficult and time consuming picking the fallen or trapped fish leading to losses in the quantity of fish. Additionally, when the fish could not be removed from the crevices, with time, they blackened and decomposed.
2. Another challenge with the hygienic processing the women had identified was that drying times were longer with the closed racks than on the bare ground.
3. During drying, the fish stuck together and had to be manually separated. According to them, drying on the ground was better in terms of the size (bigger) and appearance (whiter) and as such most processors prefer the ground drying.
4. They also realized that fish dried on the bare ground “expanded” whereas fish dried on the racks became too dehydrated and smaller leading to losses in income generated.

Suggestions:

1. They suggested that the netting of the racks is put on top, with the wire mesh below as a support. In so doing, the fish is unable to fall through the netting.
2. To speed up the drying process, they indicated that they preferred that the racks be left opened during drying.

When asked why they were not developing any of the products they were trained on, they revealed that they were very interested in the *shitor* made from sun-dried fish. However because it was the lean season for small fish, their immediate focus was on smoking the little they get and salt mining. They anticipated that during the bumper season from August to September, they will commence the *shitor* processing because all other needed ingredients will be in abundance. They would have wished that the racks were fairly distributed among them for individual usage.

At Tema Newtown, it was realized that there was no collaboration between the President of NAFPTA (National Association of Fish Processors and Traders) and the Fish Processors hampering development in the fish processing area. The land given by NAFPTA for the construction of the raised drying platform was not in consultation with the Fish Processors. The site, according to the women was too far and thus they could not keep an eye on the fish during the drying. They therefore used the drying racks to dry fish by inclining it on stands within their fish smoking compound. With respect to the hammer mill, Tema Metropolitan Assembly had installed 2 additional mills for them. One for solely processing fish meal and the other 2 for milling sun-dried and smoked fish. They asked for an additional hammer mill from the team if possible.

On the whole, it was realized that the women had understood the message of hygienic processing of fish and given the right situation and removal of bottlenecks and other challenges, they would put into practice what they had learned from the Small Fish Food training. And if they had up-takers who will buy from them directly at a higher cost than sold in the open markets for their efforts. It was the lean season for fish and it was observed that sun-drying on bare ground was not even observed. The women also complained about the effect of *saiko* fishing on aquatic life as well as on their livelihoods. None of the processors was involved in value addition ventures they learnt from the team. A visit to the platform site showed overgrown weeds all around it.

Engagement with community leaders and fish processors at Moree, Adina and Tema Newtown.

Scenes from the landing beach at Moree and drying platform site

Racks, hammer mills and drying platform site at Tema Newtown

Fish drying on open racks

Fish stuck on racks

Picking of fish lodged in corners of rack

Hammer mill shed at Adina

Observation by the team

The team observed from the first evaluation that even though the processors at the three communities showed a lot of enthusiasm before and during the construction of the platforms, they were not being used. The adoption level was very low or absent. They appeared abandon especially at Moree and Tema. The team also believe that, the leadership at Adina at least have used the racks on the platform that was why they were able to provide enough feedback to the team. The training on hygienic drying practices and value addition to sundried fish didn't yield the positive outcome the team was hoping for. Despite some challenges such as the lean season, the construction of landing beach, the siting of the platform and others had hampered its full use, the women obviously prefer the ground drying over the raised platforms. There is therefore a need for intensive

awareness creation and education for these women processors to adopt these technologies and innovations.

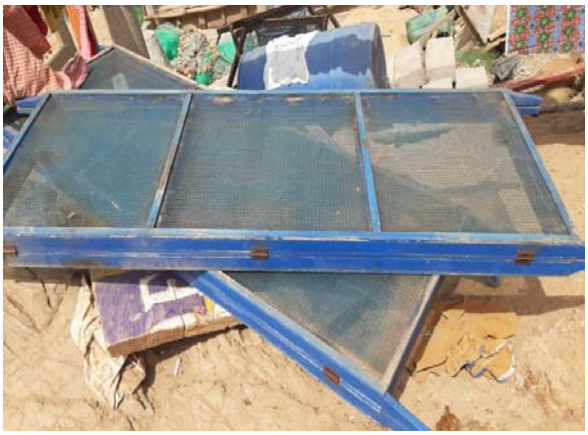
Second Evaluation

The second evaluation was undertaken in December 2021. The team embarked on a field trip to the four fishing communities to observe uptake of the technology and enquire if they were facing further challenges with use of the technologies transferred. The situational report is as follows:

Moree

At Moree, as a result of the on-going construction of the fish landing site, fishing activities had declined. The women also complained of declining fish stocks hence scarcity of fish in Moree. The Chief fisherman explained that the racks were sited farther away from the landing site therefore as he had indicated to the team earlier, when the landing site is completed, the racks will be moved to a site easily accessible by the women. In the time being, he had distributed the racks to the women to use in drying their fish closer to their homes. The team therefore visited some of the women processors to ascertain this. The women confirmed that, they were more comfortable using the racks individually than when it was kept for group usage. The team however noticed the poor handling of the racks as some were already looking old. The sealer and hammer mill were not in use at the time of the visit.

Meeting with Chief Fisherman at Moree




Moree: Racks placed easily assessable to the women


Interaction with some of the women who were given some of the racks


Moree fish platform site and hammer mill, the current situation

Scenes from Moree

Adina

The situation in Adina was no different, the chief fisherman and the women complained of dwindling fish stocks, and a host of challenges in the fishing trade such as unavailability of fuel which could be linked to interference from key community leaders in charge of its sale and distribution, as well as high cost of fuel for their boats. However, it was an exciting moment for the team when they observed that a processor nearby was washing her fish in two bowls of potable water as recommended to them by the team during the training activities. The racks and milling machine were not in use at the time of visit. It was deduced from the discussions held with them that many of the processors still depended on the ground drying. They also advocated for the sharing of the racks among them.


Meeting with fishing elders and women processors at Adina


Adina fish platform site and hammer mill, the current situation

Ningo-Ahwiam

The women of Ningo-Ahwiam community also indicated that small fish was scarce, however, women who were able to get some fish dried their fish on the racks. They attested to the improved quality of the fish with regards to the absence of sand particles in and around the dried fish product. They also reported that the fish dried on the racks reduces the drudgery of removing sand compared to the previous scenario of drying on the bare ground. They had contrary views to those expressed with the initial rack design (closed racks) for the other three communities. The women processors

in Ningo-Ahwiam said drying times were shorter with the open racks, the fish did not stick together, the size and appearance were acceptable to them. They kept their racks at a centralized location, which was also close to the platforms. By reason of communal labor and understanding, anyone interested in drying had permission to use the racks. According to them they have no issues sharing and using the racks unlike the other communities. Large volumes are still dried on the ground as the racks are not enough for them all. The hammer mill was used twice in milling dried fish into powder which was neatly sealed and supplied to a local store nearby and to a caterer for *shitor* preparation during a funeral. According to them, they have announced to the community the availability of the hammer mill for commercial purposes for income generation.

Financial challenges posed a real threat to their livelihood. This was made known to the FRI Team through the leadership of the women processors. They identified the importance of capital to revamping their businesses and wandered if the Project could extend some support in that respect. The PI explained that the project does not have such mandate and advised that instead of the women assessing a loan that would come with huge interest rates, they could rather engage in a savings scheme (locally referred to as '*susu*') where they contribute a specific amount each week/month and the total given to a particular member weekly/monthly. She cautioned however that only committed members should be allowed to join such a scheme. An experiment to compare the drying rate of the open rack to the closed rack was also carried out at Ningo-Ahwiam to ascertain if a faster rate of drying accounted for the acceptance of the open racks.


Ningo-Ahwiam: Meeting with the leadership of the processors


Ningo-Ahwiam: Platform, racks and hammer mill

Tema New Town

At Tema New Town, the issues experienced in the other communities with scarity of fish was not evident. There seemed to be a bumper harvest and fish was being dried on the ground as has been the practice prior to the introduction of hygienic drying training. The Tema Metropolitan Assembly (TMA) had supported with the construction of the shed and two additional hammer mills to support with fish milling activities. The representative of the Assembly, Mr. George Dzeto indicated that with the support of the new mayor, they planned to construct more drying racks and improve fish handling activities at Tema. He also proposed that at an appropriate time, the team would be invited to meet with the newly appointed Mayor to discuss issues relating to safe fish processing in the Tema Metropolitan Assembly as this has been identified as a major problem.

Local storage of dried fish

Sun-drying of fish at the time of the visit (December 2021)

Sweeping of fish after drying


Tema Newton: Constructed shed and inspection of hammer mills in the shed

Up-taker

The project team packaged fish powder in small sizes for a potential up-taker in the Northern Region as samples to test its acceptance for porridge fortification for children. Positive feedback was received. It is the hope of the smallfishfood project team to get other up-takers on board who can purchase the hygienically processed fish at a higher price to boost the technology uptake. Otherwise many processors will still depend on drying the fish on the bare ground.

Samples of milled anchovies

2021 Publications

Akonor, Paa T., Amy Atter, Margaret Owusu, Jonathan Ampah, Anthonia Andoh□Odoom, Ragnhild Overå, Marian Kjellevold, Johannes Pucher, and Jeppe Kolding. (2021). Anchovy powder enrichment in brown rice□based instant cereal: a process optimization study using Response Surface Methodology (RSM). *Food Science & Nutrition*. doi.org/10.1002/fsn3.2424.

Training manual for improved sun drying of small fish and development of small fish based food products (CSIR-FRI/MA/AA/2021/001).

Ragnhild Overå, Amy Atter, Anthonia Andoh-Odoom, Jonathan Ampah, Paa T. Akonor, Margaret Owusu, Akosua Darkwah, Margaret Masette, Samuel Edgar Tinyiro and Cyprian Ogombe Odoli. Challenges and potentials for diffusion of improved fish processing technologies in Africa. (Submitted to FAO/ANFTS for publication).

Mass media popularization (Ghana New Agency Online Publication)

Create wealth from 'trash fish'- Fish processors told. Dated 13th October 2021 by Albert Oppong-Ansah. https://www.gna.org.gh/1.21223056.

Conclusion

The year under review saw the completion of the outstanding objectives (construction of racks and platforms; hammer mills, donation of sealer machine, technology transfer and training) of the SmallFish Food Project. An evaluation of the uptake of technologies was undertaken and feedback obtained showed that generally, many processors even though liked the innovations and were happy with the project interventions still depend on traditional methods. Some processors were using the drying racks especially in Ningo-Ahwiam without complains. This may be largely attributed to the open type of racks they benefitted from as they dry faster according to them. At Adina, it was observed that some practices had been adopted from the hygienic handling training, but fish catch was low due to light-fishing and saiko-fishing according to the processors. The women in Ningo-Ahwiam had used the hammer mill in milling some fish. In Moree, the racks were in use by individual processors who dry their fish closer to their homes while waiting for the completion of the landing site and subsequent relocation of the platforms. In Tema, fish drying practices were as before the training and large volumes of fish were being dried on the ground. Experimental analysis were also conducted on nutrient profile, acceptability, safety and quality during storage of sun-dried fish powder and fish fortified products. Attempt at getting up-takers on board was made but more awareness creation is needed to achieve this goal. Awareness

creation, identification and availability of ready markets/up-taker is key in this drive otherwise progress will not me made. The project also churned out scientific publication and technical report for which details have been presented in this report.